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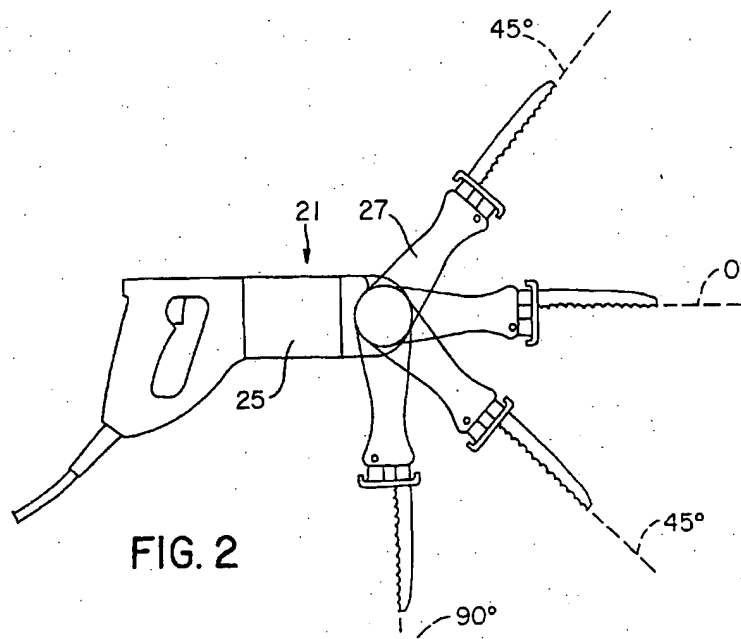
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(54) A reciprocating saw with an angular blade drive and rotatable blade holder

(57) According to one aspect of the invention, a reciprocating saw 21, 154 comprises a housing 23, 154 pivotable about a first axis 29. A blade holder 49 is mounted for reciprocation along a second axis 53 perpendicular to the first axis. An angular blade drive train 61 is directly connected between a motor 43 and the blade holder. The angular blade drive permits the blade axis of reciprocation 55 to be adjusted in a plane parallel to the saw sidewalls 177. Drive train 61 consists solely

of a rotary section 63 and a reciprocating section 65. The rotary section is connected directly between the motor and the reciprocating section. The reciprocating section is connected directly to the blade holder. According to a second aspect of the invention, a reciprocating saw 21, 154 comprises a housing 23, a drive train 61, a blade holder 49, and a connector 59. Blade holder 49 is rotatably mounted in connector 59 for rotation about an axis 53 parallel to and spaced from an axis 55 of reciprocation of output bar 57.



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## Description

This invention relates to a saw and more particularly relates to a reciprocating saw that is used typically for rough cutting applications.

Reciprocating saws are used by variety of tradesmen such as plumbers, electricians and carpenters for both remodelling and new construction. Many of the applications require the saw to be used in confined locations that restrict the manoeuvrability of the saw. Conventionally such saws have an elongated, integral housing and have the blade fixed for reciprocation in a single plane. In U.S. 5,193,281 and PCT application W094/00264, it has been suggested that greater versatility can be added by providing an attachment with an angular blade drive for the saw. As used herein, "angular blade drive" means a drive that would permit the blade axis of reciprocation to be adjusted in a plane parallel to the sidewalls of the saw (i.e., to be pivoted about an axis perpendicular to the longitudinal axis of the saw housing). The disclosed blade drives all comprise various drive mechanisms for converting the normal reciprocating output of the saw to rotary and then back to reciprocating. The PCT application also suggests that the blade drive may be integrated into the main body of the saw. In the latter case the main body of the housing is pivotable to permit the blade axis to be varied. Both publications also disclose blade holders that are adjustable so that the blade may be rotated about its axis of reciprocation to increase its ease of use.

The saws disclosed in both publications still fail achieve the desired level of compactness, durability, balance and simplicity.

The present invention has multiple aspects. One aspect is directed to a saw with an angular blade drive and a pivotable housing permitted the saw to be more easily used and manoeuvred in a wider variety of applications. According this aspect, a saw comprises housing with a first section and a second section pivotally attached to the first section for rotation about a first axis. The first section contains a motor with a rotary output shaft. A blade holder is mounted for reciprocation along a second axis perpendicular to the first axis. An angular blade drive train is directly connected between the motor output shaft and the blade holder. The drive train consists solely of a rotary section and a reciprocating section. The output of the motor is connected directly to the input of the rotary section. The output of the rotary section is directly connected to the input of the reciprocating section. The output of the reciprocating is directly connected blade holder.

Through such a drive train the rotary motor output is converted to reciprocating motion solely one time.

The drive train may comprise a bevel gear and scotch yoke drive, a spur gear and scotch yoke drive, or a crank and connecting rod drive.

The reciprocating section of the drive train preferably comprises a saw bar mounted for reciprocating mo-

tion in the second or bar section of the housing.

The pivotable connection between the first or motor housing section and the bar housing section preferably comprises a front portion of the motor section and a rear portion of the bar housing section overlapping the motor housing section.

A second aspect of the invention is directed to saw with a blade holder that is rotatable about the axis the of blade reciprocation. Such a saw is again easier to use and more manoeuvrable in a wide variety of applications. The first and second aspects may be used together or independently in a saw. According to the second aspect, a saw comprises a housing and a motor disposed in the housing and having a rotary output shaft. A drive train is connected to the motor output shaft and converts rotary to reciprocating motion. The drive train mechanism has an output bar mounted in the housing for reciprocation along a first axis. A blade holder is provided for mounting a blade for reciprocation along a second axis parallel to and spaced from the first axis. A rigid connector is connected to the bar and mounts the blade holder for rotation about the second axis. The connector transmits in phase the reciprocating motion of the bar to the blade holder.

The housing preferably comprises a first section and a second section pivotally connected to the first section for pivoting about a third axis perpendicular to the first axis.

The drive train may comprise any of the drive trains usable with the first aspect of the invention and may also use conventional drive trains for converting rotary to reciprocating motion such as a wobble plate drive.

A latch is preferably mounted on the connector and is engageable and disengageable with the blade holder to respectively lock and unlock the blade holder against rotation about the third axis.

Other aspects of the invention will be apparent from reviewing the appended claims.

The accompanying drawings which are incorporated in, and constitute a part of, this specification illustrate in schematic form three embodiments of the invention and together with the description serve to explain the principles of the invention. In the drawings, the same reference numerals indicate the same parts.

Figure 1 is a perspective view of a reciprocating saw in accordance with the present invention.

Figure 2 is a side elevational view of the saw shown in Figure 1 illustrating that the saw housing is angularly adjustable.

Figure 3 shows a side elevational view of the saw of Figure 1 and illustrates an application for the saw when the blade is oriented to reciprocate in a plane perpendicular to the side walls of the saw.

Figure 4 shows a side elevational view of the saw of Figure 1 and illustrates an application for the saw when the blade is oriented with the saw teeth projecting upwardly.

Figure 5 is a fragmentary cross-sectional top view

of the bottom half of the saw shown in Figure 1 according to a first embodiment of the present invention incorporating a bevel gear and scotch yoke drive train.

Figure 6 is a cross-sectional side view of the saw of Figure 1 taken generally along line 6-6 of Figure 5.

Figure 7 is a fragmentary side elevational view taken along line 7-7 of Figure 5.

Figure 8 is a fragmentary cross-sectional view of a second embodiment of a reciprocating saw in accordance with the present invention incorporating a crank and connecting rod drive train. In Figure 8, the view is taken along line 8-8 of Figure 9 delineating a plane extending from the top to the bottom of the saw.

Figure 9 is a fragmentary cross-sectional view of the saw taken along line 8-8 of Figure 8.

Figure 10 is a schematic partially cross-sectional side view of a third embodiment of the present invention using a spur gear and scotch yoke drive train.

Figure 11 is a fragmentary cross-sectional view taken along line 11-11 of Figure 10.

Figure 12 is a fragmentary partially cross-sectional view of the front end of the saw of Figure 1.

Figure 13 is a cross-sectional view taken along line 13-13 of Figure 12.

Figure 14 is a fragmentary view similar to Figure 12 except that a blade is mounted in the blade holder to illustrate one orientation of the blade. In this orientation, the blade is oriented parallel to the saw housing side walls with the saw teeth facing downwardly.

Figure 15 is a fragmentary view similar to Figure 14 except that a second orientation of the blade is illustrated. In this orientation, the blade is oriented parallel to the saw housing sidewalls with the saw teeth facing upwardly.

Figure 16 is a fragmentary schematic view similar to Figure 14 and 15 except that a third orientation of the blade is illustrated. In this orientation, the blade is oriented perpendicular to the saw housing sidewalls with the saw teeth facing to the left of the tool.

The preferred embodiment of a saw according to the present invention is illustrated in Figure 1-7 and 12-16. Alternative embodiments of a drive train for a saw of the present invention are illustrated, respectively, in Figure 8 and 9 and Figure 10 and 11.

The preferred embodiment is a reciprocating saw 21 that may be typically used by carpenters, plumbers and electricians for rough sawing applications. The first aspect of the invention relates to a saw with an angular blade drive and a pivotable housing. As shown in Figure 1, saw 21 comprises a housing 23 including a first or motor section 25 and second or bar section 27 pivotally connected to the first section for rotation about a first axis 29 to permit housing 25 to be selectively adjusted into a plurality of angular configurations. As shown in Figure 2, preferably front section 27 may be selectively adjusted through an angular range of 135°. If the in line position of the housing is chosen as 0°, front section 27 may be pivoted between approximately -45° and 90°.

Preferably, as shown in FIG. 5, bar housing 27 has a rear portion 31 overlapping a front portion 33 of motor housing 25. Portions 31, 33 are pivotally connected at a joint 35 formed by sandwiching front portion 33 between an annular bearing surface 37 of rear portion 31 and a plate 40 rigidly attached to bar housing 27 by screws 38. Plate 40 has a circular opening 39 surrounding a cylindrical projecting hub 41 of front portion 33.

Although not depicted, housing 23 would preferably include a latch for locking the location of bar section 27 relative to motor section 25. Such a latch would be released to permit adjustment of housing section 27 and then related to securely lock section 27 into its adjusted position.

According to the invention, saw 21 further comprises a motor 43 located in the first or motor section and having a rotary output shaft 45 supported in a bearing 46. Motor 43 is preferably a universal motor but other types may be used. Preferably, motor shaft 45 has a integrally formed pinion 47 at its distal end.

According to the invention, saw 21 further comprises a blade holder 49 for mounting a blade 51 for reciprocation along a second axis 53 perpendicular to the first pivot axis 29. As will be explained in accordance with the second aspect of the present invention, blade holder 49 is offset from the axis of reciprocation of an output saw bar 57 by connection of holder 49 to bar 57 through a rigid connector 59. The purpose for offsetting blade axis 53 and bar axis 55 and the function of connector 59 will be explained in detail below in connection with Figures 12-16.

According to the invention, saw 21 further comprises an angular blade drive train 61 (Figures 5-11) directly connected between motor output shaft 45 and blade holder 49 for reciprocally driving holder 49 reciprocally along axis 53. Drive train 61 consists of a solely rotary section 63 and a solely reciprocating section 65. Rotary section 63 has an input 67 directly connected to motor output shaft 45. An output 69 of rotary section 63 is directly connected to an input 71 of reciprocating section 65. An output 73 of reciprocating section 65 is directly connected to blade holder 49. Drive train 61 may also constitute a drive train means for converting the rotary motor output to a reciprocating drive input 71 to saw bar 57 by converting rotary to reciprocating movement solely one time. As will be appreciated, the present invention provides significant advantages compared to prior art saws discussed above that convert rotary to reciprocating motion twice. Preferably drive train 61 may be constituted by a bevel gear and scotch yoke drive train 72 depicted in Figures 5-7. Alternatively, drive train 61 may be constituted by a crank and connecting rod drive train 74 in accordance with a second embodiment of the invention depicted in Figures 8 and 9 or a spur gear and scotch yoke drive train 76 in accordance with a third embodiment of the present invention depicted in Figures 10 and 11.

As shown in Figures 5-7, the bevel gear and scotch

yoke drive preferably comprises an input spur gear 67 fixed at one end of a shaft 75 rotatably supported in bearings 77, 79. Shaft 75 has a pinion 81 that is formed opposite spur gear 67 and drives an output bevel gear 69. Gear 69 drives input 71 of the reciprocating section 65 through a cam shaft 83, bearing 84, and cam follower 85 of the scotch yoke 87. Cam shaft 83 extends from a rear face 89 of output bevel gear 69 parallel to the axis of rotation 29 of the housing sections 25, 27. Bevel gear 69 is fixed to a support shaft rotatably supported in spaced bearings 93, 95 for rotation about axis 29 which is also the axis for pivotal movement of bar housing 27 relative to motor section 25.

Drive train 61 further comprises output bar 57 integrally formed with scotch yoke 87 and connector 59 fixed to the distal end of bar 57. Bar 57 is constrained for linear reciprocation in bearing 97. Bearing 97 comprises a pair of spaced guides 99, 101, spaced pairs of ball bearings 103, 105 supported, respectively, in channels 107, 109 in bar 57.

In operation of the bevel gear and scotch yoke drive of Figures 5-7, the rotary output from motor 43 is transmitted to shaft 75 through pinion 47 and input spur gear 67. Rotation of shaft 75 is transmitted to output bevel gear 69 through pinion 81 drivingly engaged with bevel gear teeth 91. Rotation of bevel gear 69 is transmitted and converted to a reciprocating drive input to saw bar 57 through scotch yoke 87, cam shaft 83 and cam follower 85. As output bevel gear 69 is rotated, cam shaft 83 moves in a circular path about axis 29 and reciprocally drives bar 57. As bar 57 is reciprocally driven, bearing pairs 103, 105 roll reciprocally back and forth in channels 107, 109.

As shown in Figures 8 and 9, when drive train 61 is constituted by the crank and connecting rod drive, drive train 61 is identical to the bevel gear and scotch yoke drive train shown in Figures 5-7 except that rotary shaft 75 serves as an input to a crank disc 111 for driving crank rod 113 thereby converting rotation of crank disc 111 into reciprocating movement of output saw bar 57. Crank disc 111 is supported on a shaft 115 rotatably supported in bearings 117, 119. Shaft 115 is rotatable about an axis 127 that is preferably coaxial with housing pivot axis 29. However, if desired, axes 29 and 127 can be parallel and offset. Shaft 115 is driven by shaft 75 through a bevel gear 121 fixed to shaft 115. Crank rod 113 is pivotally connected to disc 111 by pin 123 and pivotally connected to bar 57 by a pin 125. Bar 57 is supported in a pair of bearings 129, 131 that are preferably identical to bearing 97 in Figure 6.

In operation of the crank and connecting rod drive 74 of Figures 8 and 9, rotary output from motor 45 is transmitted through shaft 75, pinion 81 to bevel gear 121 fixed to shaft 115. Crank disc 111 (fixed to shaft 115) provides a rotary output (from rotary section 63) to crank arm 113 that serves as an input to reciprocating section 65.

As shown in Figures 10 and 11 when drive train 61

is constituted by the spur gear and scotch yoke drive 76, drive train 61 comprises a rotary section 63 constituted solely by spur gears and a reciprocating section 65 constituted by a scotch yoke, cam shaft and cam follower assembly identical to the first embodiment shown in Figures 5-7 except that cam shaft 83 is fixed for rotation in a disc 128 rather than an output bevel gear 69 in Figure 5. Also, saw bar 57 is supported for linear reciprocating movement in a pair of bearings 129, 131 identical to bearing 97 in Figure 5 rather than a single bearing 97 as used in the first embodiment.

Rotary section 63 of drive train 61 in the third embodiment shown in Figures 11 and 12 is constituted by three spur gears 133, 135, 137 for transmitting the rotary output from motor output shaft 45 and spur gear pinion 139 to disc 128. Spur gears 133, 135 are integrally formed and are supported in a pair of bearings 141, 143. Spur gear 137 and disc 128 are fixed to and supported on a shaft 145 rotatably supported in bearings 147, 149 for rotation about an axis 151.

Because of the different configuration of drive train 76 and the orientation of motor 43, transverse to saw bar 57, the configuration of saw housing 152 for the third embodiment of a saw 154 according to the present invention is different from housing 23 for saw 21. Housing 152 has a motor section 155 and a bar section 157 pivotally connected to bar section 157 for rotation about an axis 159.

Housing sections 155, 157 are pivotally connected through a tongue and groove joint 155. Axes 151 and 153 are coaxial and as in the case of housing 23, bar section may be pivoted through a range of angles extending approximately between -45° and 90° (when an inline orientation is chosen as 0°).

In operation of spur gear and scotch yoke drive 76 (Figures 10, 11), the rotary drive output of motor 43 is converted to a reciprocating drive input to saw bar 57 through spur gears 133, 135, 137 and disc 128 which together constitute a rotary section of drive train 61 having an input spur gear 133 and an output disc 128. Disc 128 provides a rotary output to the input 71 of reciprocating section 65 through cam shaft 83 and cam follower 85 of scotch yoke 87. Saw bar 57 is integrally formed with scotch yoke 87 and is thus linearly reciprocally driven back and forth along axis 55.

A second aspect of the present invention illustrated in Figures 3, 4 and 12-16 permits saw 21 to be usable in a greater variety of applications. This is accomplished by mounting blade holder 49 for rotation about its axis of reciprocation. According to this aspect of the invention, a reciprocating saw 21 comprises housing 23, which in its broadest application need not be pivoted; a drive train 61, which in its broadest application need not be angularly adjustable; blade holder 49 and connector 59. Drive train 61 may take the forms shown in Figures 5-11, namely, a bevelled gear and scotch yoke drive 72, a crank and connecting rod drive 74 and a spur gear and scotch yoke drive 76. Alternatively, conventional no-

angular drive trains for converting rotary motion to reciprocating motion such as a wobble plate drive may be used in lieu of drive train 61.

According to this aspect of the present invention, blade holder 49 mounts a blade 51 for reciprocation along axis 53 parallel to and spaced from axis 55. Rigid connector 59 is fixed to bar 57 and mounts blade holder 49 for rotation about axis 53. Connector 49 transmits in phase the reciprocating motion of bar 57 to blade holder 49.

Preferably, as shown in Figure 13, blade holder 49 has a latch 163 with a tongue 165 that is selectively engageable in one of a plurality of pockets 167 formed at 90° intervals around the periphery of a shank 171 of holder 49. Latch 163 is pivotally connected to connector 59 by a pin 173 and is spring biased into a latched position by a coiled spring 175. When latch 163 is pivoted counterclockwise about pin 173, tongue 165 is pivoted out of pocket 161, and holder 49 can be selectively rotated manually about axis 53 for positioning of blade 51 at 90° intervals. Thus, as shown in Figure 14, blade 51 may be located in a plane parallel to housing sidewall 177 with blade teeth 179 facing downwardly. As shown in Figure 15, blade 51 may be located in a plane parallel to housing sidewall 177 with blade teeth 179 facing upwardly. And, as shown in Figure 16, blade 51 may be located in a plane transverse to housing sidewalls 177 with the teeth 179 facing to the left of tool 21 (i.e., facing toward the plane of the page in Figure 16). Alternatively, blade 51 may be located in a plane transverse to the sidewall 177 with the teeth 179 facing to the right of tool 23 (i.e., with the teeth facing outwardly of the plane of the page of Figure 16).

Figures 3 and 4 illustrate two applications for which saws 21, 154 with a rotatable blade holder are particularly suited. In Figure 3, with the blade oriented as shown in Figure 16, blade 51 may be used to cut closely adjacent to an inside corner 181 of a right angular workpiece 183. In Figure 4 with the blade oriented as shown in Figure 15, blade 53 may be used to cut an overhead workpiece 185 attached to a planar work surface 187.

Those skilled in the art will recognise that the present invention offers a number of advantages. First, by integrating the angular blade drive into the basic drive train of the saw, the overall length of the saw is no longer than conventional reciprocating saws. The balance of the drive train is maintained when the saw housing is adjusted through the range of angles. And, an angular blade drive is achieved by converting rotary to reciprocating motion solely one time compared to prior art systems that require conversion of rotary to reciprocating motion twice. Secondly, the saw has improved versatility and manoeuvrability particularly when working in confined locations. Thirdly, when the rotatable blade holder is used with the angular blade drive even greater versatility and manoeuvrability is achieved without sacrificing compactness.

## Claims

### 1. A reciprocating saw comprising:

a housing having a motor section and a bar section pivotally connected to the motor section for rotation about a first axis;  
a motor in the housing and having a rotary motor shaft;  
an angular drive train for converting rotary movement to reciprocating movement comprising (a) a blade drive bar mounted in the bar section for reciprocation about a second axis perpendicular to the first axis; and (b) a rotary shaft located at the forward end of the motor section and connected to the motor shaft;

characterised in that the angular drive train comprises a gear located at the rear end of the bar section, connected between the blade drive bar and the rotary shaft and rotatably drivable about a third axis generally coaxial to the first axis to reciprocally drive the blade drive bar.

### 2. The saw of claim 1 wherein the drive train comprises a scotch yoke drive.

### 3. The saw of claim 1 wherein:

the rotary shaft has a pinion at its forward end and a spur gear formed at its rear end;  
the gear is a bevel gear drivingly connected to the pinion.

### 4. The saw of claim 1 wherein:

the input gear has a first face;  
a cam shaft extends from the first face parallel to the first axis; and  
the saw bar has a cam follower connected to the cam shaft.

### 5. A reciprocating saw comprising:

a motor housing;  
a bar housing pivotally mounted to the motor housing for rotation about a first axis;  
a motor in the motor housing and having an armature shaft providing a rotary output;  
a saw bar mounted for reciprocation in the bar housing and connectable at one end to a blade;  
a gear train connected directly between the armature shaft and a second end of the saw bar;

characterised in that:

the gear train for receiving a rotary input from the armature shaft and providing a reciprocating

ing input to the bar and consisting solely of rotary components up to the reciprocable saw bar; and  
the gear train converting rotary to reciprocating movement solely one time.

6. The saw of claim 5 wherein:

the pivotable connection between the motor and bar housings comprises a front portion of the motor housing, rear section of the bar housing overlapping the motor housing, and a plate attached to the bar housing and sandwiching the front section against the rear section of the motor housing.

7. The saw of claim 1 wherein:

the motor housing has a front portion;  
the bar housing has a rear portion overlapping the front section;  
the rotary shaft of the drive train and the gear of the drive train are at least partially housed within the overlapping front and rear sections.

8. The saw of claim 1 further comprising:

a blade holder for supporting a blade for reciprocation about a third axis offset from and parallel to the second axis;  
a connector fixed to the saw bar and rotatably supporting the blade holder for rotation about the third axis; and  
a latch mounted on the connector engageable with the blade holder to lock the blade holder against rotation about the third axis and disengageable with the blade holder to unlock the blade holder for rotation about the third axis.

9. The saw of claim 8 wherein:

the holder comprises a plurality of pockets; and  
the latch comprises a tongue engageable and disengageable in the pockets to lock and unlock, respectively, the blade holder.

10. The saw of claim 8 wherein:

the connector transmits in phase the reciprocation of the saw bar to the blade holder.

11. A reciprocating saw comprising:

a housing comprising a first section and a second section pivotably connected to the first section for rotation about a first axis;  
a motor located in the first housing section and having a rotatory output shaft;  
a blade holder for mounting a blade for reciprocation along a second axis perpendicular to the first axis;

an angular blade drive train directly connected between the motor output shaft and the blade holder for reciprocally driving the blade holder;

characterised in that the drive train consists of (a) a solely rotary section having an input and an output, the input directly connected to the motor output shaft and (b) a solely reciprocating section having an input and an output, the reciprocating section input directly connected to the rotary section output and the reciprocating section output directly connected to the blade holder.

12. The saw of claim 11 wherein the drive train comprises a scotch yoke drive.

13. The saw of claim 11 wherein the drive train comprises:

a rotary shaft having a pinion at its forward end and a spur gear formed at its rear end; and  
a bevel gear drivingly connected to the pinion.

14. The saw of claim 11 wherein the drive train comprises:

a gear having a first face;  
a cam shaft extends from the first face parallel to the first axis; and  
a saw bar comprising a cam follower connected to the cam shaft.

15. The saw of claim 11 wherein the pivotable connection between the first and second housing sections comprises:

a front portion of the first section,  
a rear portion of the second section overlapping the front portion, and  
a plate attached to the second section and sandwiching the front portion against the rear portion.

16. The saw of claim 11 wherein:

the drive train comprises a saw bar mounted to the second section for reciprocation along a third axis offset from and parallel to the second axis;  
a connector fixed to the saw bar and rotatably supporting the blade holder for rotation about the third axis; and  
a latch mounted on the connector engageable with the blade holder to lock the blade holder against rotation about the third axis and disengageable with the blade holder to unlock the blade holder for rotation about the third axis.

## 17. The saw of claim 16 wherein:

the holder comprises a plurality of pockets; and  
the latch comprises a tongue engageable and  
disengageable in the pockets to lock and un-  
lock, respectively, the blade holder.

## 18. The saw of claim 11 wherein:

the drive train is selected from the group consisting  
of a crank and connecting rod drive, a bevel gear  
and scotch yoke drive, and a spur gear and scotch  
yoke drive.

## 19. The saw of claim 11 wherein:

the drive train comprises a scotch yoke drive includ-  
ing a pinion shaft connected to the motor output  
shaft, a bevel gear connected to the pinion shaft and  
an output bar connected to a reciprocally driven by  
the bevel gear.

## 20. The saw of claim 11 wherein:

the drive mechanism comprises a crank and con-  
necting rod drive including a pinion shaft connected  
to the motor output shaft, a bevel gear connected  
to the pinion shaft, a crank connected to the bevel-  
led gear and a connecting rod connected to and re-  
ciprocally driven by the bevel gear.

## 21. The saw of claim 11 wherein:

the drive mechanism comprises a spur gear and  
scotch yoke drive including a first spur gear con-  
nected to the motor output shaft, a second spur gear  
connected to the first spur gear and a saw bar con-  
nected to and reciprocally driven by the second spur  
gear.

## 22. A reciprocating saw comprising:

a motor housing;  
a bar housing pivotally mounted to the motor  
housing for rotation about a first axis;  
a motor in the motor housing and having an ar-  
mature shaft providing a rotary output;  
a saw bar mounted for reciprocation in the bar  
housing and connectable at one end to a blade;  
a gear train connected directly between the ar-  
mature shaft and a second end of the saw bar;

characterised by a drive train means for converting  
the rotary motor output to a reciprocating drive input  
to the saw bar by converting rotary to reciprocating  
movement solely one time.

## 23. A reciprocating saw comprising:

a housing;  
a motor in the housing and having a rotary out-  
put shaft;

a drive train connected to the motor output shaft  
and for converting rotary to reciprocating mo-  
tion;

the drive train having an output bar mounted in  
the housing for reciprocation along a first axis;  
a blade holder for mounting a blade for recip-  
rocation along a second axis parallel to and  
spaced from the first axis;

a rigid connector, connected to the bar and  
mounting the blade holder for rotation about the  
second axis;

characterised in that the connector transmits in  
phase the reciprocating motion of the bar to the  
blade holder.

## 24. The saw of claim 23 wherein:

the housing comprises a first section and a second  
section pivotably connected to the first section for  
pivoting about a third axis perpendicular to the first  
axis.

## 25. The saw of claim 24 wherein:

the drive mechanism is directly connected be-  
tween the motor output shaft and the blade  
holder and reciprocally drives the blade holder;  
and  
the drive mechanism consists of (a) a solely ro-  
tary section having an input and an output, the  
input directly connected to the motor output  
shaft and (b) a solely reciprocating section hav-  
ing an input and an output, the reciprocating  
section input directly connected to the rotary  
section output and the reciprocating section  
output directly connected to the blade holder.

## 26. The saw of claim 25 wherein:

the drive mechanism is selected from the group  
consisting of a crank and connecting rod drive, a  
bevel gear and scotch yoke drive, and a spur gear  
and scotch yoke drive.

## 27. The saw of claim 24 wherein:

the drive mechanism comprises a scotch yoke drive  
including a pinion shaft connected to the motor out-  
put shaft, a bevel gear connected to the pinion shaft  
and an output bar connected to and reciprocally  
driven by the bevel gear

## 28. The saw of claim 24 wherein:

the drive mechanism comprises a crank and con-  
necting rod drive including a pinion shaft connected  
to the motor output shaft, a bevel gear connected  
to the pinion shaft, a crank connected to the bevel-  
led gear and a connecting rod connected to and re-  
ciprocally driven by the bevel gear.

29. The saw of claim 24 wherein:

the drive mechanism comprises a spur gear and scotch yoke drive including a first spur gear connected to the motor output shaft, a second spur gear connected to the first spur gear and a saw bar connected to and reciprocally driven by the second spur gear.

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30. The saw of claim 1 wherein:

the pivotable connection between the motor and bar housings comprises a front portion of the motor housing, rear section of the bar housing overlapping the motor housing, and a plate attached to the bar housing and sandwiching the front section against the rear section of the motor housing.

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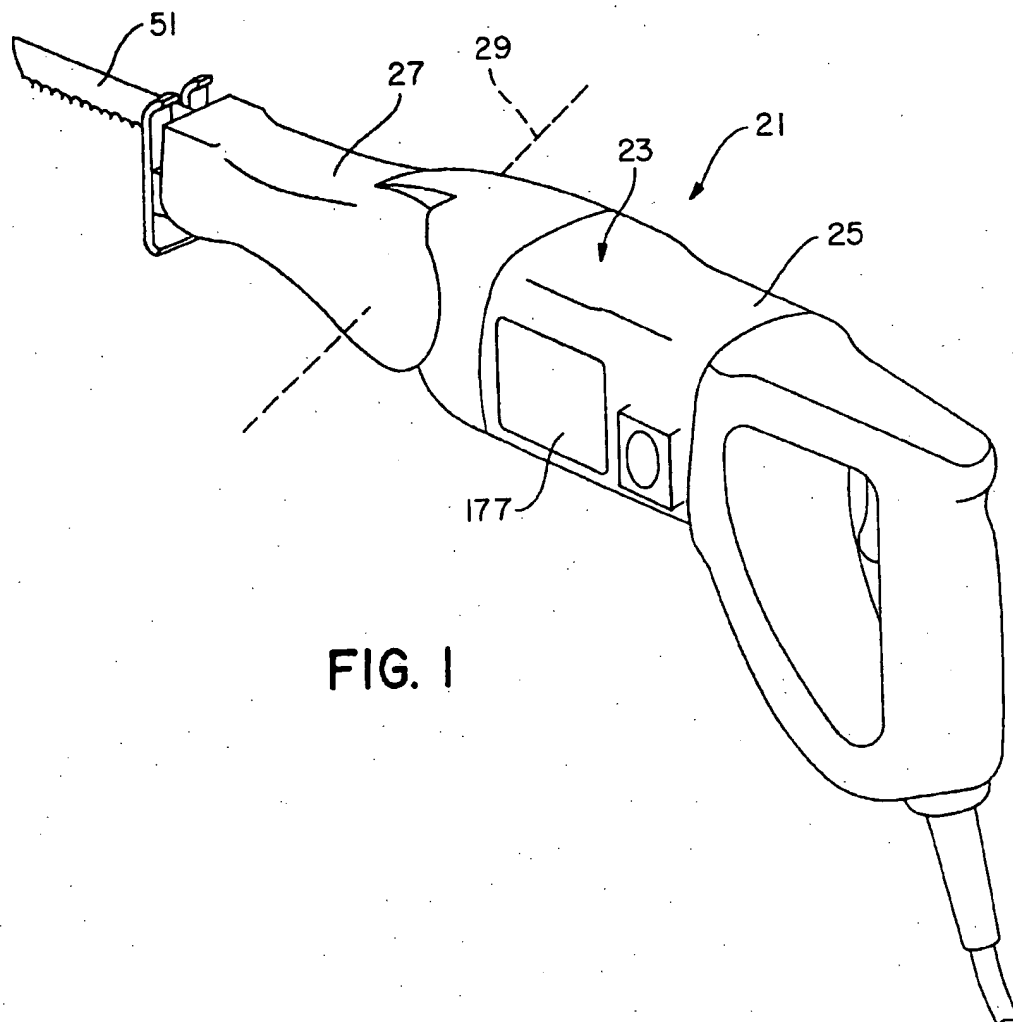
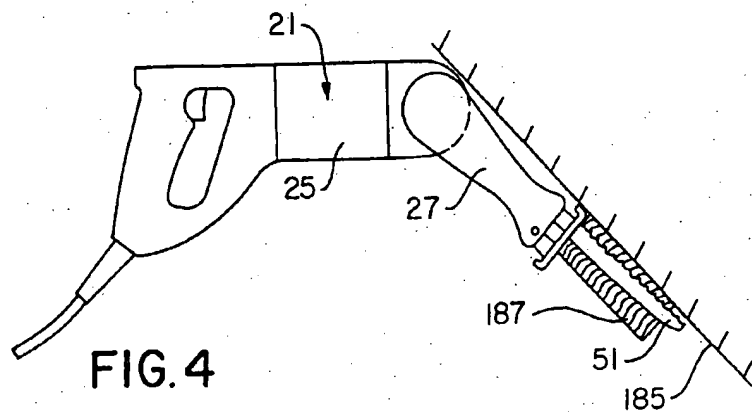
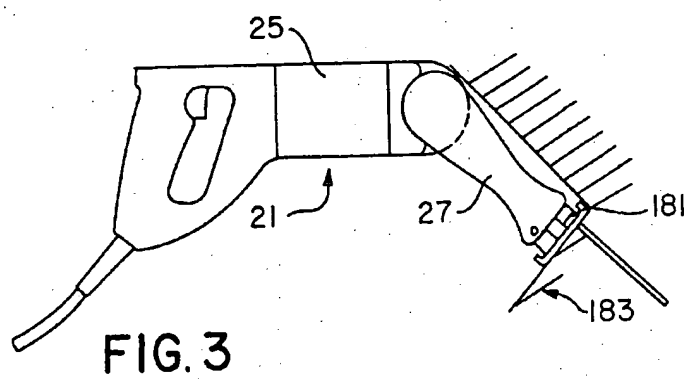
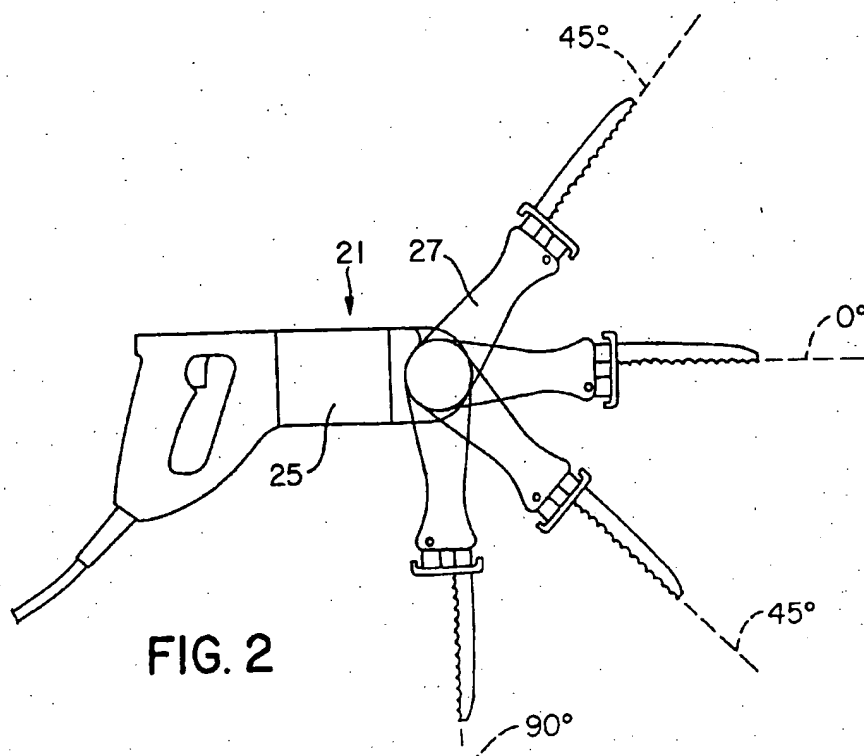
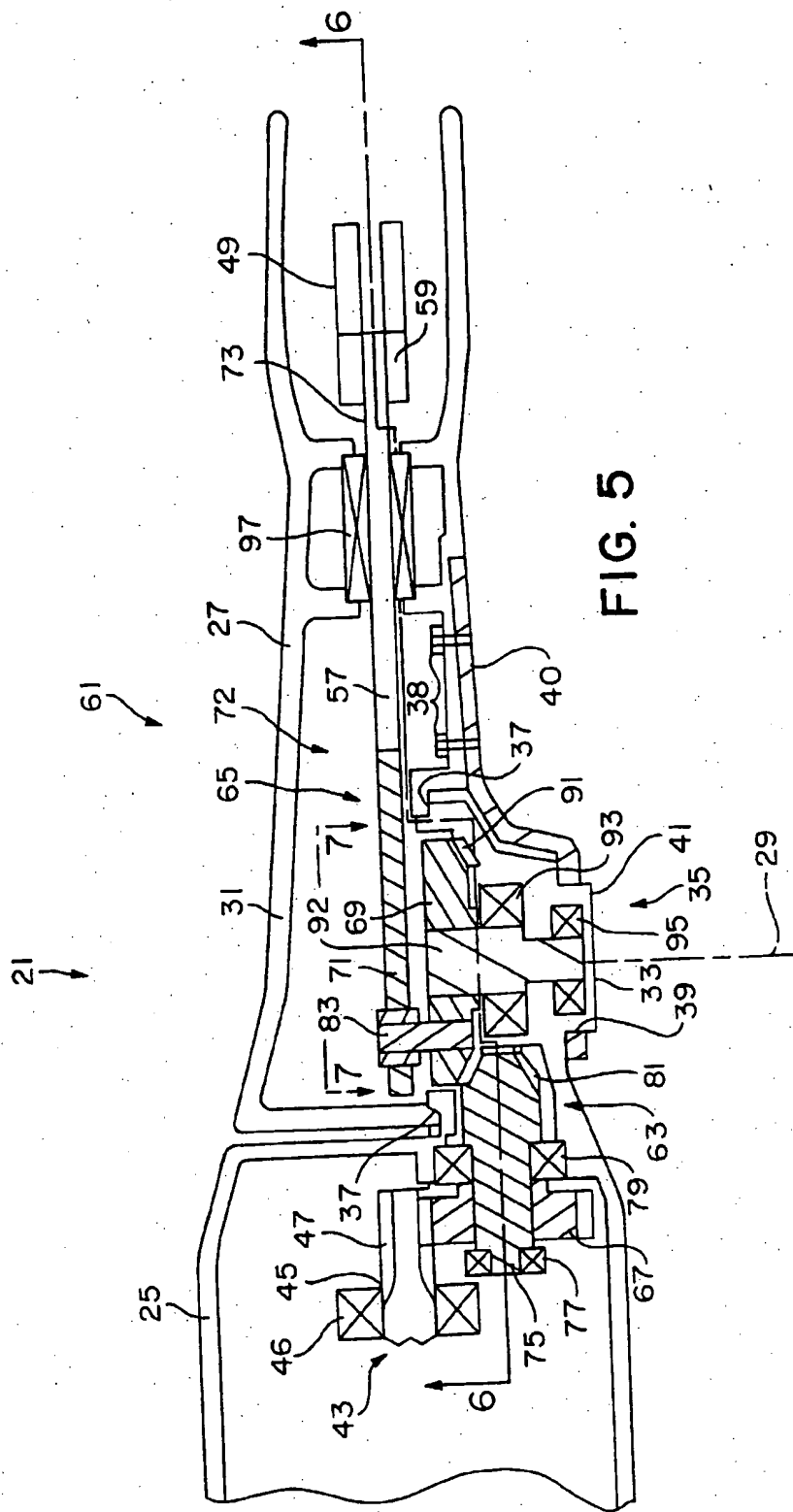
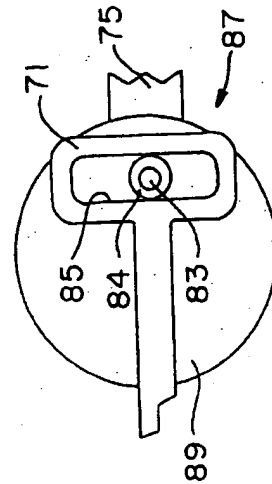
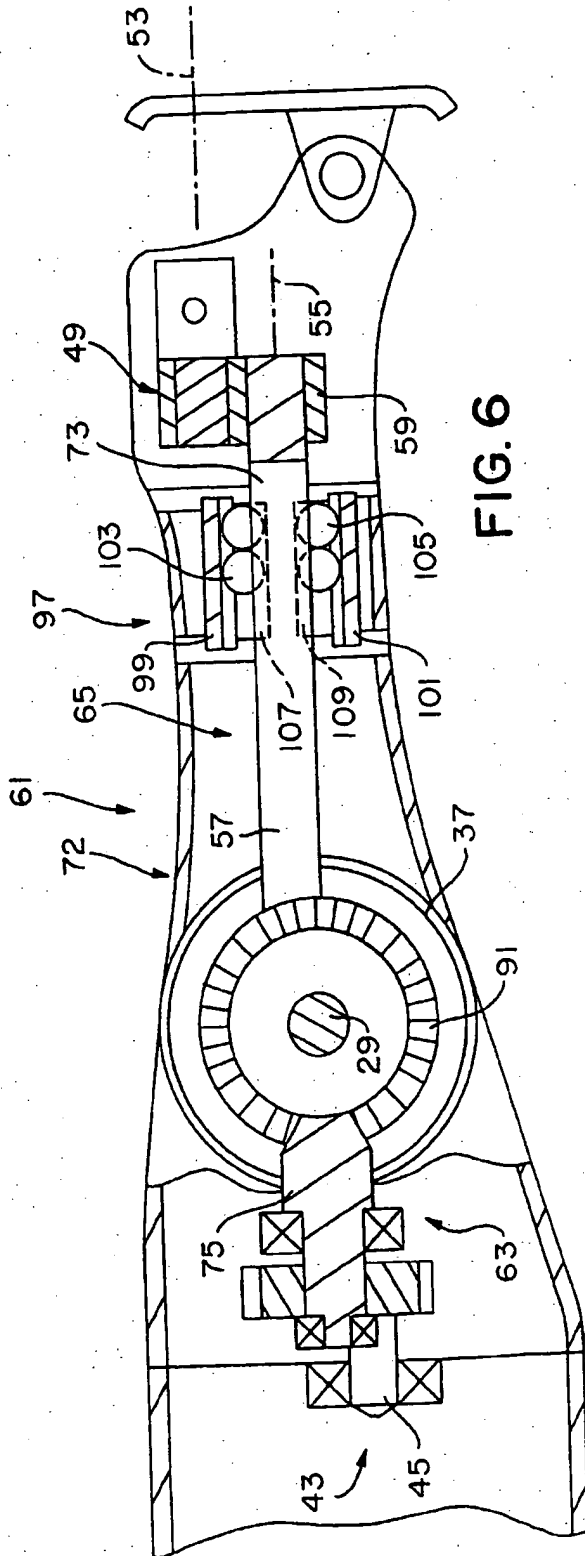
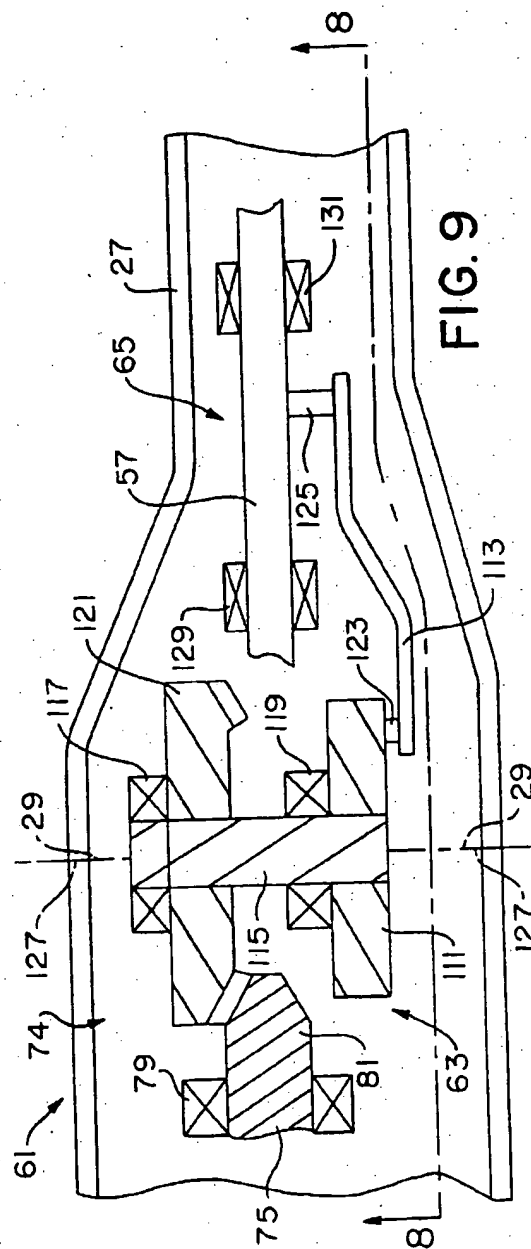
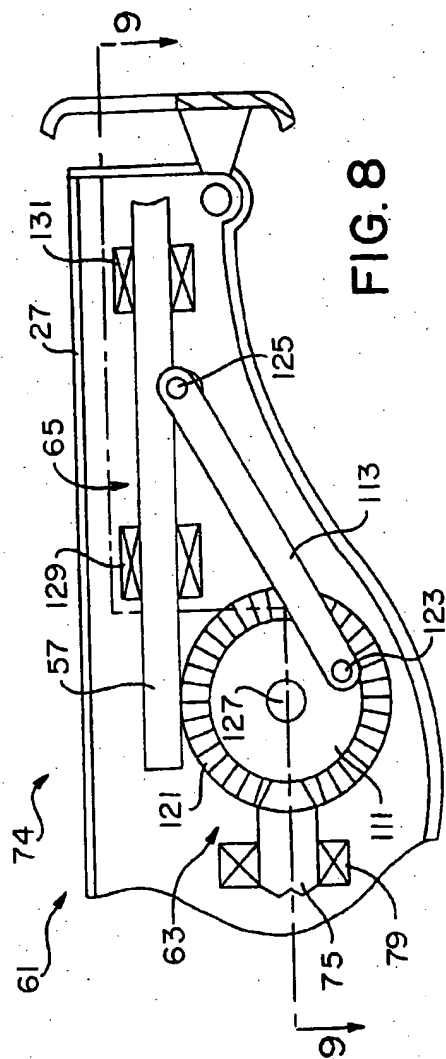


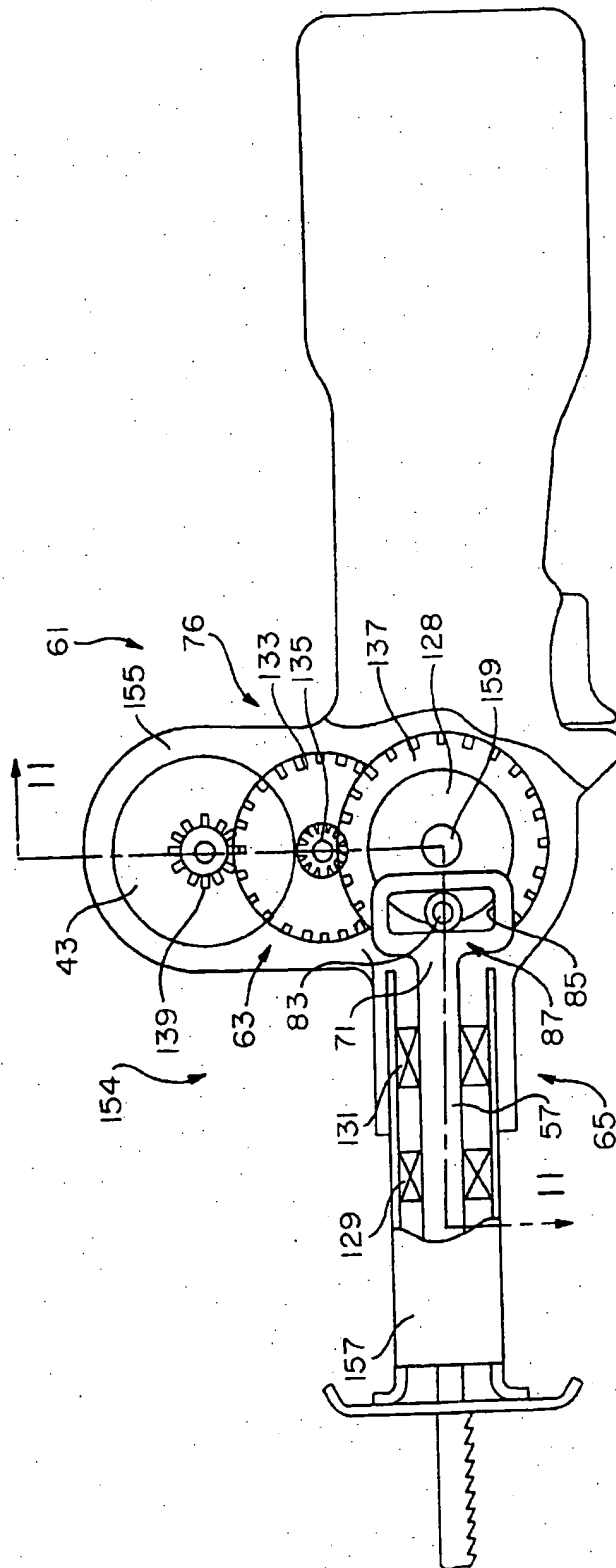
FIG. 1



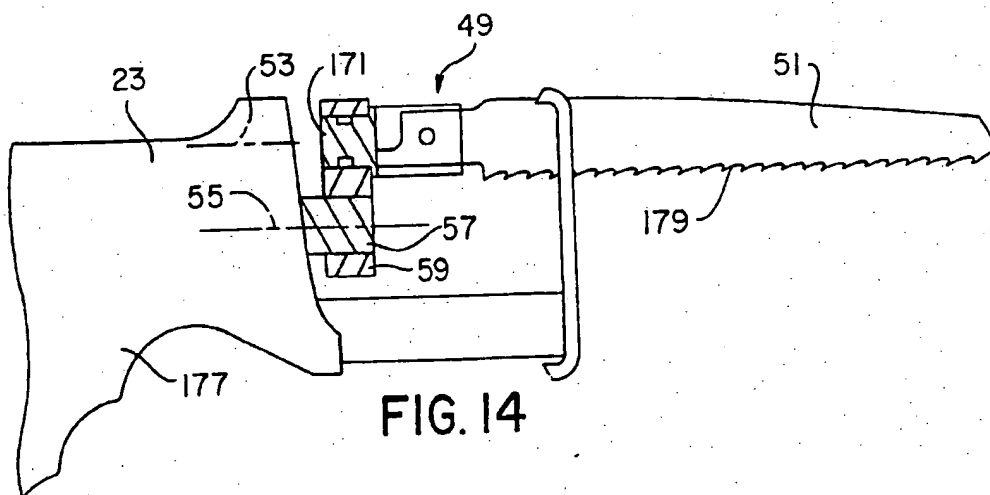
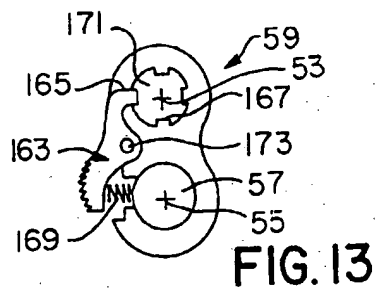
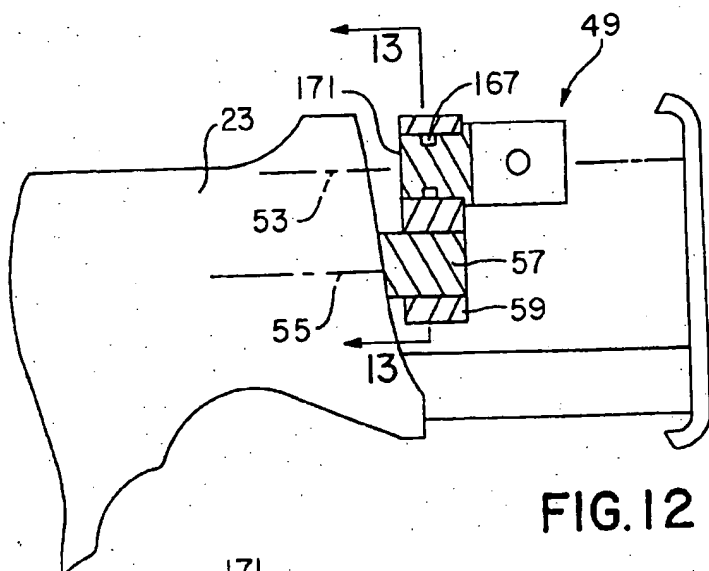




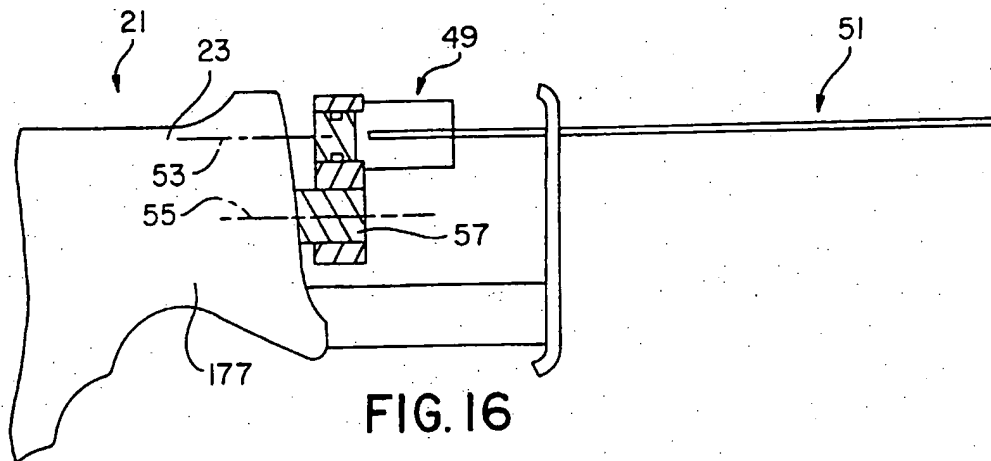
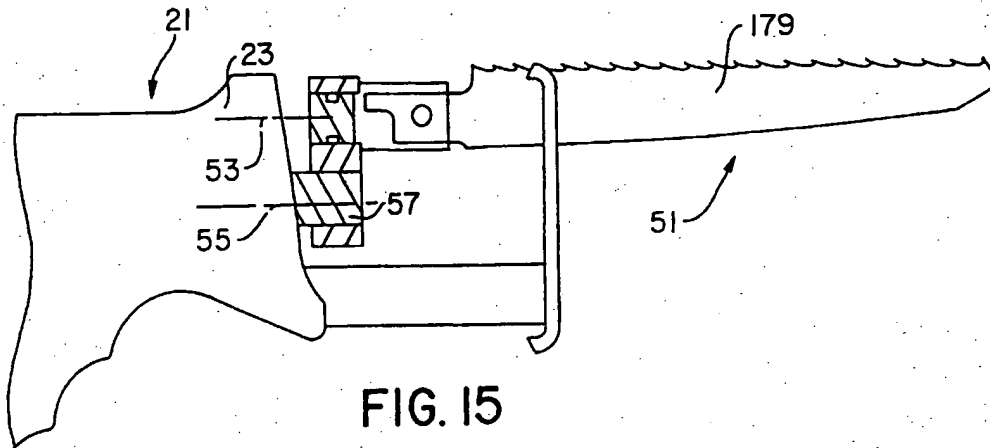












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